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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/807,222	03/24/2004	Junji Noguchi	XA-10063	3353

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MILES & STOCKBRIDGE PC  
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SUITE 500  
MCLEAN, VA 22102-3833

EXAMINER

FENTY, JESSE A

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 08/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/807,222

Applicant(s)

NOGUCHI ET AL.

Examiner

Jesse A. Fenty

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 25 May 2006.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-21 and 40-48 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21, 40-48 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 17-21 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee (US 2003/0008493 A1).

In re claim 17, Lee (e.g., Fig. 2J) discloses a semiconductor device, comprising:

- a semiconductor substrate (200);
- a first insulating film (210) formed over said semiconductor substrate;
- a wiring (240 having a first conductive film containing copper as a primary component, and embedded in said wiring opening;
- a second insulating film (260) formed over said wiring and said first insulating film; and
- a third insulating film (270) formed over said second insulating film,

wherein a barrier property of a material constituting said second insulating film to copper is larger than that of the material constituting said third insulating film, and

wherein an adhesiveness of the material constituting said third insulating film has a greater adhesiveness than the material constituting said second insulating film to a material constituting said fourth insulating film.

The limitations, "... restraining and preventing ..." and "...controlling stress." are recitations of the intended use of the device. Terms that simply set forth the intended use, a property inherent in or a function, do not differentiate the claimed composition of these elements from those known to prior art.

In re claims 18 and 19, Lee discloses the device of claim 17. The limitations, "... relaxes stress ..." and "... generates a compression stress ..." are intended use language that does not further define the structure of the invention from the structure of the prior art. As claimed, the prior art structure reads on the claimed structure. Therefore, the prior art structure will inherently function in the same manner as the claimed structure.

In re claim 20, Lee discloses the device of claim 17, wherein said second insulating film is SiCN (Lee, section [0021]).

In re claim 21, Lee discloses the device of claim 17, wherein said third insulating film is made of silicon carbide (Lee, section [0022]).

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-8, 10-16, 40-44 and 46-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (US 2003/0008493 A1) in view of Ko (US 2004/0067658 A1)

In re claims 1 and 13, Lee (e.g., Fig. 2J) discloses a semiconductor device, comprising:

- a semiconductor substrate (200);
- a first insulating film (210) formed over said semiconductor substrate;
- a wiring (240 having a first conductive film containing copper as a primary component, and embedded in said wiring opening;
- a first barrier insulating film (260) formed over said wiring and said first insulating film;
- a second barrier insulating film (270) formed over said first barrier insulating film;
- wherein a barrier property of said first barrier insulating film to copper is larger than that of said second barrier insulating film to the copper, and

Lee does not expressly disclose the second insulating film (280) formed on said second barrier insulating film having a lower dielectric constant than that of an oxide silicon film. Ko et al. (e.g., Fig. 1F) discloses a second insulating film (34) atop two barrier layers having a lower dielectric constant than that of a silicon oxide film. It would have been obvious for one skilled in the art at the time of the invention to use a low-k dielectric layer as disclosed by Ko for the device of Lee for the purpose, for example, of

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enabling smaller device size and higher density of semiconductor devices on a substrate (Ko; section [0003]);

wherein the material constituting said second barrier insulating film has a greater adhesiveness than the material constituting said first barrier insulating film to a material constituting said second insulating film.

In re claim 2, Lee in view of Ko discloses the device of claim 1, wherein the thickness of said first barrier insulating film (Lee, section [0021]) is thicker than that of said second barrier insulating film (Lee, section [0022]).

In re claim 3, Lee in view of Ko discloses the device of claim 1, wherein the thickness of said first barrier insulating film is 40nm (400 angstroms) or less (Lee, section 0021)).

In re claim 4, Lee in view of Ko discloses the device of claim 1. The limitation, "formed by a coating or CVD method" refers to the process for making this product and does not further define the claimed structure, therefore is not given patentable weight.

In re claim 5, Lee in view of Ko discloses the device of claim 1, wherein said wiring has a barrier conductive film (230) formed on a bottom surface and a side surface of said wiring opening, and said first conductive film formed over said barrier conductive film.

In re claim 6, Lee in view of Ko discloses the device of claim 1, wherein said first barrier insulating film is made of SiCN (Lee, section [0021]).

In re claim 7, Lee in view of Ko discloses the device of claim 1, wherein said second barrier insulating film is made of silicon carbide (Lee, section [0022]).

In re claim 8, Lee in view of Ko discloses the device of claim 1, wherein said second insulating film is made of a material containing SiCO (Ko; section [0025]).

In re claim 10, Lee in view of Ko discloses the device of claim 1. The limitation, "is nitrided" refers to the process for making this product and does not further define the claimed structure, therefore is not given patentable weight.

In re claim 11, Lee in view of Ko discloses the device of claim 1, wherein a third insulating film (28, Ko) is formed between said first insulating film (26, Ko) and said first barrier insulating film (30, Ko).

In re claim 12, Lee in view of Ko discloses the device of claim 11, comprising many insulating and barrier films but does not expressly disclose a fourth insulating film formed between said first and third insulating films. It would have been obvious for one skilled in the art at the time of the invention to use a fourth insulating or barrier layer between the first and third insulating films for the purpose, for example, of providing greater support within the semiconductive device, providing an etch stop, or diffusion barrier as is well known in the art.

In re claim 13, Lee (as above) discloses a semiconductor device comprising:

- a semiconductor substrate (200);

- a first insulating film formed over said semiconductor substrate;

- a wiring opening formed in said first insulating film;

- a wiring having a first conductive film containing copper as a primary component, and embedded in said wiring opening;

a second insulating film formed over said wiring and said first insulating film and made of a material including silicon and carbon and at least one of nitrogen and oxygen;

a third insulating film made of silicon carbide and formed over said second insulating film; and

wherein a barrier property of a material constituting said second insulating film to copper is larger than that of a material constituting said third insulating film, and

wherein the material constituting said third insulating film has a greater adhesiveness than the material constituting said second insulating film to a material constituting said fourth insulating film.

Lee does not expressly disclose the fourth insulating film (280) formed on said third barrier insulating film having a lower dielectric constant than that of an oxide silicon film. Ko et al. (e.g., Fig. 1F) discloses a fourth insulating film (34) atop two barrier layers having a lower dielectric constant than that of a silicon oxide film. It would have been obvious for one skilled in the art at the time of the invention to use a low-k dielectric layer as disclosed by Ko for the device of Lee for the purpose, for example, of enabling smaller device size and higher density of semiconductor devices on a substrate (Ko; section [0003]);

In re claim 14, Lee in view of Ko discloses the device of claim 13, wherein said fourth (top) insulating film (34) comprises SiCO (Ko; section [0025]).

In re claim 15, Lee in view of Ko does not expressly disclose the nitrogen content in said barrier insulating film being greater towards the bottom of the film than that of the



higher. It would have been obvious to one skilled in the art at the time of the invention to form the claimed structure, because one of ordinary skill in this art is aware that the nitrogen will inherently settle to the bottom of the layer during and after thermal processing, as is known in the art.

In re claim 16, Lee in view of Ko discloses the device of claim 13, wherein said fourth (top) insulating film (34) comprises SiCO (Ko; section [0025]).

In re claim 40, Lee in view of Ko discloses the device of claim 13, wherein the thickness of said second insulating film is greater than that of said third insulating film.

In re claim 41, Lee in view of Ko discloses the device of claim 13, wherein the thickness of said second insulating film is 40nm or less.

In re claim 42, Lee in view of Ko discloses the device of claim 13. The limitation, "formed by a coating or CVD method" refers to the process for making this product and does not further define the claimed structure, therefore is not given patentable weight.

In re claim 43, Lee in view of Ko discloses the device of claim 13, wherein said wiring has a barrier conductive film (230) formed on a bottom surface and a side surface of said wiring opening, and said first conductive film formed over said barrier conductive film.

In re claim 44, Lee in view of Ko discloses the device of claim 13, wherein said fourth insulating film is made of a material containing silicon, oxygen, and carbon.

In re claim 46, Lee in view of Ko discloses the device of claim 13. The limitation, "is nitrided" refers to the process for making this product and does not further define the claimed structure, therefore is not given patentable weight.

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In re claim 47, Lee in view of Ko discloses the device of claim 13, wherein a fifth insulating film is formed between said first insulating film and said second insulating film.

In re claim 48, Lee in view of Ko discloses the device of claim 47, wherein a sixth insulating film is formed between said first insulating film and said fifth insulating film.

3. Claims 9 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Ko as applied to claims 1 and 13 above, and further in view of Hironaga et al. (US 2003/0173671 A1).

In re claims 9 and 45, Lee in view of Ko discloses the devices of claims 1 and 13 respectively, but does not expressly disclose a copper compound film formed over a surface of the wiring. Hironaga (esp. Fig. 3) discloses a copper compound film (34a) atop wiring layer (26a). It would have been obvious for one skilled in the art at the time of the invention to use a copper silicide layer as disclosed by Hironaga atop the copper wiring layer of Lee/Ko for the purpose, for example, of enhancing the conductivity of the wiring line.

### ***Response to Arguments***

Applicant's arguments filed 05/25/06 have been fully considered but they are not persuasive.

Applicant acknowledges that the primary reference of Lee is deficient in detailing the material composition of the second insulating layer (280). However, the secondary

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reference of Ko was provided to show that the claimed low-k materials as claimed were well known in the art at the time of the invention.

In their response, applicant asserts that the characterization of the layer (34) of Ko as anti-reflection or etch-stop is insignificant, and adds that such layers are remote from the copper wiring (22). However, applicant does not explain how this difference is relevant to the claim and works to eliminate the rejection of Lee in view of Ko from reading on the claims.

Moreover, applicant does not address the argument made by the examiner in the body of the rejection which combines the teachings of Lee and Ko and provides adequate motivation to combine the references.

For at least these reasons, the rejection based on the references is maintained.

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jesse A. Fenty whose telephone number is 571-272-1729. The examiner can normally be reached on M-F 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JAF



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SUPERVISORY PATENT EXAMINER